

# Fatigue Facts for Aviators & Everyone Else!



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*Although written with the aviator in mind, the precepts in this article apply to all Air Force personnel. — Editor*

**F**atigue impairs alertness and performance, often without your awareness. In fact, sleepiness/fatigue can be as dangerous as intoxication. Just 18 hours without sleep causes mental and motor skills to deteriorate as much as they do when blood alcohol concentration (BAC) reaches 0.05 percent. Twenty-four hours of sustained wakefulness equates to a BAC of 0.10 percent, the legal intoxication limit in most states. Fatigue is a significant risk factor in aviation as well as ground operations, but the consequences of being tired are too often underestimated or ignored.

## What Is Fatigue?

The terms "fatigue" and "sleepiness" are often used interchangeably. One definition of fatigue describes it as a subjective state of tiredness associated with prolonged work and/or prolonged wakeful-

ness (or sleep loss). This may be experienced differently by different people. One of the reasons the risks associated with fatigue or sleepiness are underestimated is that no biological markers or "Breathalyzers™" for fatigue exist. Thus, it's difficult to determine how many accidents and other problems are associated with fatigue. Fatigue-related impairments are underreported because sleepy pilots, drivers, and workers are reluctant to admit they fell asleep (or even became inattentive) on the job, especially if an accident results.

## Is Fatigue a Big Problem?

Despite the fact fatigue is difficult to measure, there's plenty of evidence that fatigue-related problems have reached almost epidemic proportions. As a society, we sleep too

little and ignore our biological clocks. The demands of everyday life have reached the point where slumber is routinely sacrificed for work, family, and recreation. As a result, approximately 63 million Americans chronically suffer

from moderate or severe daytime sleepiness. And because of this, on-the-job concentration, decision making, problem solving, and performance are adversely affected.

Forty percent of adults now say their daily sleep is inadequate. Much of this is simply due to the fact people go to bed too late and get up too early or don't sleep well due to stress or other factors. Also, the requirement to work rotating shifts leads to disrupted or insufficient sleep. There are over 25 million shift workers in the United States, many of whom find it impossible to stay alert during their night jobs because sleeping during the day is contrary to the body's internal biological clock. Thus, there are a lot of sleep-deprived people in America, and many of them are in the military.



Interestingly, however, most of us see our sleepiness as a badge of honor or rather than as a condition to be remedied. Twenty-six percent of career-minded adults feel sleepiness is part of the price to be paid for being successful. In the military, commanders place a high value on troops who "tough it out" despite the fact these individuals are increasing accident risks because they are suffering from dangerous alertness deficits.

### Is Fatigue Worse at Some Times of the Day Than at Others?

The simple answer to this question is yes. Human beings have a number of biological rhythms (for hormone secretions, temperature, etc.) which are synchronized to 24-hour cycles by exposure to daylight, knowledge of clock time, meal intervals, and activity schedules. Because of these rhythms, alertness is greater during the day than the night, and research has shown people not only feel sleepier at nighttime, but perform less skillfully as well.

For instance, it's been found that truck drivers fall asleep behind the wheel more frequently at night (after midnight) than during the day. Also, they are seven times more likely to be involved in a drowsy driving accident between midnight and 0800 than at other times. Studies of truckers have shown that time of day is more likely to impact driving performance than the amount of time on duty or the number of consecutive trips.

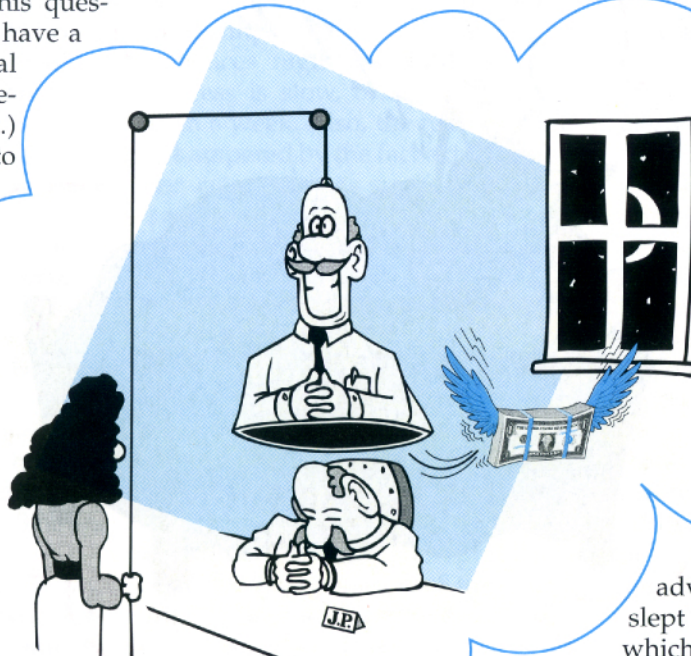
In a variety of other occupations, errors and accidents have been shown to increase at night. Thus, time of day is as important a determinant of fatigue as is the amount of wakefulness since the last sleep period. However, both of these factors work together to influence alertness levels, and because of this,

both must be considered when attempting to minimize sleepiness on the job.

### What Are the Costs Associated With Fatigue?

Unfortunately, sleep deprivation affects almost every aspect of daily functioning, but attention, complex thinking, judgment, decision making, and motivation are the most vulnerable. As a result, it's estimated \$18 billion in U.S. industrial productivity is lost every year because of sleepiness on the job.

On the highways, drowsiness



costs more than \$12 billion a year in lost productivity and property damage. About 1,500 deaths and 76,000 injuries occur annually because drivers fall asleep while traveling.

Besides these costs at work and on the highways, many of the over 50 percent of aviation mishaps chalked up to human errors are directly related to fatigue and sleepiness in the cockpit. Some have described flying as "long periods of boredom interspersed with seconds of sheer terror," and it's now known this boredom (associated with flying routine, uneventful missions) places pilots at greatest risk for

falling asleep at the controls. Passive monitoring tasks (such as navigating at altitude) are the most susceptible to being botched as a result of sleep deprivation.

### Why Are We So Tired?

Two of the major causes of fatigue are (1) inadequate sleep prior to work and/or (2) extended periods of wakefulness (as in sustained operations). Although the military, the trucking and railway sectors, and commercial aviation have sought to combat fatigue by restricting the amount of time spent working, there's little clear evidence hours of work, per se, adversely affect performance as long as adequate daily sleep is obtained. Instead, the most readily identifiable cause of fatigue is sleep loss. This is alarming since chronic sleep deprivation in America is on the rise.

At the turn of the century, before the advent of electric lights, people slept 9.5 hours per day, most of which was at night (since artificial lighting was inadequate for working during hours of darkness). However, many of us now sleep less than 7 hours per day, and some segments of the population (i.e., shift workers) sleep even less. As a result, sleep deprivation is taking a heavy toll on job productivity, personal safety, and well being.

### What Are the Warning Signs of Inadequate Nightly Sleep?

In general terms, excessive sleepiness at work indicates insufficient sleep while off duty. Sleepiness (fatigue) can result either from acute periods of deprivation ("pulling an all-nighter") or from chronically shortened sleep periods across several days (leading to cumulative sleep debt). Indicators of inadequate

continued on next page



sleep include:

- Difficulty waking up without the aid of an alarm clock.
- Repeatedly pressing the snooze button to sneak in a few extra minutes of sleep.
- A strong desire to take naps during the day.
- Difficulty staying awake while in meetings, riding in a car, or watching TV.
- Falling asleep rapidly after going to bed at night (usually in less than 5 minutes).
- Looking forward to weekends when one can "catch up on sleep."
- Sleeping 2 or more hours than usual on days off.

Many fatigued people blame their sleepiness on boredom or on inactivity. However, in well-rested individuals, boredom causes a feeling of irritation or agitation and not the irresistible urge to nod off which results from sleep deprivation.

### How Much Sleep Is Necessary to Be Fully Alert?

There are substantial variations in sleep needs from one person to another, but on average, adults need about 7 to 9 hours of nightly sleep to be fully alert during the day. Although there are some people who can get by on much less sleep, it's not possible to accurately predict which individuals are "short sleepers" and which are "long sleepers." Age, fitness level, intelligence, motivation, and personality appear to have no reliable relationship to sleep needs. In fact, the only way to determine sleep requirement is by trial and error. However, learning how much sleep is necessary (and ensuring this much is obtained) is essential to remain fully awake on the job. Studies have shown the loss of even 2 hours of sleep during a single night is enough to significantly

degrade next-day alertness.

### How Can I Determine How Much Sleep Is Right for Me?

Individual sleep needs can be determined in two ways. The best way is by studying your own behavior while on your next vacation, particularly if the vacation is a couple of weeks long. However, it's possible to determine sleep needs during nonvacation times as well.



- **While on vacation**, sleep until you wake up without an alarm clock for several days and record the amount of nightly sleep. The average is how much sleep you naturally need. When trying this, start keeping records on the third day after you've overcome any pre-existing sleep debt.

- **While on a regular work schedule**, add 1 hour to your usual nightly sleep and maintain this for a week. At the end of the week, evaluate how alert you felt at work each day. If more sleep is needed, add an hour the next week, and so on.

Once your natural sleep requirement is established, carefully evaluate factors that may be preventing

adequate daily sleep. Usually, reprioritizing or simply rearranging the course of a normal day will help to ensure enough sleep to maximize on-the-job alertness.

### Can I Train Myself to Need Less Sleep?

It's a fact some people need more sleep than others. If you're one of those people, there's unfortunately no way to train yourself to get by on less than your biologically determined amount of slumber. Some people think repeated exposure to sleep deprivation improves their functioning during sustained wakefulness. This, however, is not the case. Simple tasks can be made resistant to the effects of sleep loss by overpracticing them to the point they become automatic. *But this won't work with tasks requiring thought and judgment.*

People who think they have made themselves immune to the effects of sleep deprivation through practice have actually just learned to reprioritize work tasks so sleep loss seems to have less of an impact. But their higher mental processes continue to decline while their chances of involuntarily falling asleep increase.

Furthermore, *sleep-deprived individuals are often unaware of their own impairment since sleepiness interferes with accurate self-evaluations.* Just like the drunk who boasts of being able to drive better after several drinks (and actually believes it), the reality is his performance is seriously impaired, but he is simply incapable of realizing it.

### How Can I Improve My Nightly Sleep?

If you are allowing yourself a sufficient amount of time to sleep every day but feel your sleep is less than optimal, you may be suffering from bad sleep habits. Everyone struggles



with occasional sleep problems, and one or two nights of trouble is not a major cause for concern. However, if you have insomnia for several days, weeks, or months, something is wrong. One possible cause of chronic insomnia is a medically recognized sleep disorder, but since most aviators are reasonably young and healthy, they are unlikely to be suffering from one of these (such as sleep apnea or nocturnal myoclonus). On the contrary, the sleep problems of most adults stem from behavioral or environmental factors. If you repeatedly are unable to fall asleep at night, make sure you do the following:

- Stick to a consistent bedtime and wake-up time even on weekends.
- Use the bedroom for sleep only and not for watching TV, reading, or working.
- Develop a soothing nighttime routine (take a warm bath, read for a few minutes, etc.).
- If you are a bedtime worrier, set aside an earlier time to resolve daily dilemmas.
- Once in bed, avoid watching the clock (face it away from the bed).
- Include aerobic exercise in your daily routine, but not within 3 hours of bedtime.
- Don't take naps during the day.
- Don't consume caffeine (in coffee, tea, chocolate, or medications) within 4 hours of bedtime.
- Don't drink alcohol within 3 hours of bedtime.
- Don't smoke cigarettes within an hour before going to bed.
- If you can't fall asleep, don't lie in bed awake. Instead, engage in a quiet activity until sleepy.

Adhering to these principles will help overcome chronic sleep problems because they break mental associations that prevent sleep and avoid substances known to delay or disrupt sleep. However, it may take several days or weeks for these new habits to repair the damage done by months or years of poor sleep practices.

### Is It Possible That Shift Work (or Reverse Cycle) Is Making Me Sleepy?

If you usually sleep well and feel alert but suffer from fatigue when rotating to a new work/rest schedule, you are experiencing the normal problems associated with disruptions in your body's internal rhythms (referred to as shift lag). Shift lag is similar to jet lag in terms of its effects. The primary problem is that restful sleep during daylight hours is contrary to our normal circadian rhythms. As a result, night workers often become chronically sleep deprived because they sleep 2 to 4 hours less per day than day workers.

Although shifting the biological clock improves daytime sleep (and enhances nighttime alertness), the process is slow, often taking more than a week. Also, the readjustment is hampered by the fact external timing cues (such as sunrise and sunset) conflict with the new sleep schedule. Anyone who has ever traveled from the U.S. to Europe can appreciate the difficulties associated with reprogramming the biological clock.

Even when everything (i.e., sunrise, sunset, meal times, activity, etc.) in the new time zone is fully synchronized with the new sleep schedule, fatigue, gastrointestinal discomfort, concentration problems, and insomnia persist for 8 to 10 days (or 1 day for each time zone crossed). Needless to say, shift workers suffer chronically from such problems because they rarely work the same shift for very long and, therefore, are in a constant state of readjustment. However, there are strategies that can speed adjustment to new work/rest schedules.

### What Strategies Promote Adjustment to a New Work Cycle?

Although transitioning from one shift to another will invariably cause feelings of fatigue and discomfort, certain strategies can facilitate readjustment and minimize how long the discomfort will last. These are especially important when changing from day to night shift.

- Maintain the new work/rest schedule even when off duty.
- Rapidly adjust meal times

(breakfast, lunch, and dinner) to agree with the new schedule.

- Talk to friends and family about your need to sleep at a different time than they do and gain their cooperation.

- Unplug the phone, disconnect the doorbell, put blackout shades on the windows and turn on a fan and/or use earplugs to mask out noise.

- When a solid 8 hours of sleep is unobtainable, use napping to get as much as possible.

- If possible, use a sleeping medication **under medical supervision** during the first 3 days of the new rotation.

- Judiciously use caffeine in the middle of the night shift to enhance alertness, but avoid caffeine within 3 to 4 hours of the next sleep period.

- If sleeping during the day, wear dark glasses and limit time outside before bedtime, then take a walk in the sunshine after awakening later in the day.

- If planning a night cycle, (1) try to end the mission well prior to daylight so personnel can get to bed before sunrise, (2) make sure night crews are not required to attend meetings or other activities which will interfere with sleep, and (3) in field scenarios, make meals available at reasonable times so that no one has to make a choice between eating and sleeping.

Consistent rest/activity cycles and "bright light discipline" are the most important factors when adjusting to a new schedule. Circadian rhythms are very sensitive to being reset (or to resisting resetting) by exposure to bright light.

### How Can I Safeguard My Alertness Even When I Can't Readjust to a New Shift or When the Long Missions Just Have to Be Done?

Avoiding fatigue during night flights is difficult because few people are able to fully adapt to night duty beforehand. However, even day flights can be challenging, especially when the flights are long and are sandwiched in between additional duties. Obviously, it's best to avoid flying at night if this is your

continued on next page



normal sleep time. Day flights are much safer because of improved alertness. However, if there's no flexibility in establishing when a flight will take place, the following strategies should be implemented:

- Obtain plenty of sleep before the flight (or the duty day when the flight is planned).
- If the flight is late in the day or at night, take a 45-minute nap before takeoff.
- Avoid alcohol consumption within 24 hours prior to night flights because alcohol increases fatigue by interrupting pre-mission sleep and causing blood sugar changes.
- During the flight, swap tasks (navigation, radios, etc.) between pilot and copilot to minimize boredom.
- During the flight (or immediately prior), consume caffeine for the stimulant effect.
- If possible, avoid hot refueling in favor of shutting down and walking around for a few minutes (a break every 2 hours is very helpful).
- Note that increasing radio volume and exposure to cold air do not fight off sleepiness.
- Remember that after being awake for a long time, involuntary sleep episodes will occur despite your best efforts to the contrary.

### What Are Some Warnings That Fatigue Is Becoming Too Great?

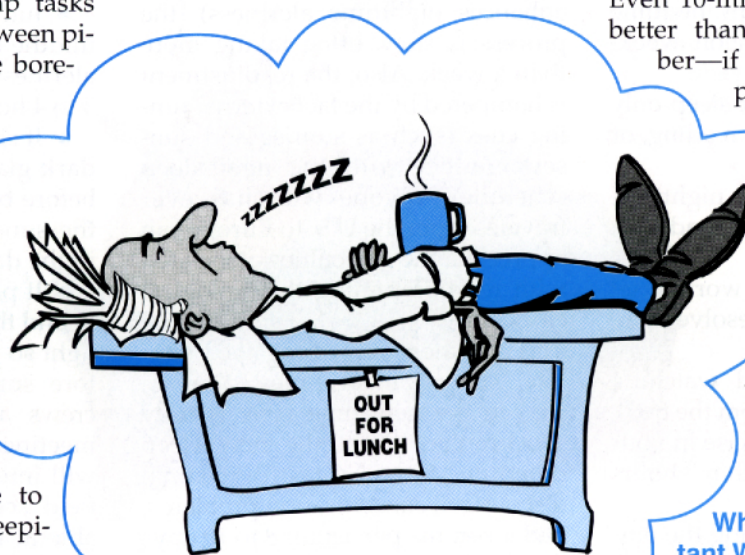
The dangers of fatigue from prolonged wakefulness, sleep deprivation, or disruptions to the body's internal clock should be obvious at this point. However, optimum mission scheduling is often impossible. When there is no choice but to fly when tired, be attuned to these indicators that falling asleep at the controls may occur in the next few seconds:

- Your eyes go in and out of focus.
- Your head bobs involuntarily.
- You can't stop yawning.
- You seem to have wandering,

disconnected thoughts.

- You don't remember things you did in the last few seconds.
- You missed a navigation checkpoint.
- You forgot to perform some routine procedure.
- Your control accuracy is degrading (altitude and airspeed fluctuate).

If you experience even one of these symptoms, the safest course of action is to end the flight as soon as possible and get some sleep. Despite popular opinion to the contrary, sleep-deprived people cannot will themselves to stay awake no matter



how hard they try. *Even personnel who think they are staying awake are susceptible to falling asleep for several seconds at a time without realizing it.* This is a serious problem given that an aircraft flying at only 90 knots can travel more than the length of a football field during a micro sleep of only 4 seconds.

### Can Napping Help?

Since one of the major contributors to fatigue is the lack of recent, restorative sleep, napping is the best countermeasure for drowsiness in prolonged missions. Several research studies have shown that long (4- to 5-hour) naps during a period of sleep loss can restore performance to near-normal levels. Also,

2- to 3-hour naps taken shortly before a period of sleep deprivation can minimize the loss of alertness and performance that would have occurred without a nap.

### How Long Should a Nap Be?

Generally, the longer the nap, the better its ability to lower the impact of fatigue. Although 2-hour naps cannot erase the effects of sleep loss, they are very beneficial because they provide sufficient time to go to sleep and complete one full sleep cycle. It takes about 90 minutes to transition from light sleep to deep sleep and then into dream sleep. Even 10-minute naps appear to be better than nothing. Just remember—

if napping is used in close proximity to the duty area, anyone who naps should be allowed at least 15 to 20 minutes to awaken before they fly or perform other complex tasks because everyone feels a little groggy when they wake up due to sleep inertia.

### What Factors Are Important When Planning Naps as a Fatigue Countermeasure?

In situations where a full sleep period is not possible because of work demands, naps can substantially reduce fatigue. When implementing strategic naps:

- Establish a relatively quiet, dark, and comfortable place for napping.
- Use sleep masks or earplugs if necessary to block out sunlight and noise.
- Place the nap when sleep is naturally easy (i.e., 1400 to 1600 or 0220 to 0600).
- Make the nap as long as possible under the circumstances.
- Consider implementing a nap in the afternoon prior to an all-night mission
- Plan the nap early in the sleep-deprivation period rather than late.
- Allow 15 to 20 minutes for sleep



inertia to dissipate before resuming work tasks.

### What if a Long Mission Is Necessary Despite No Opportunity for Sleep?

Missions that pop up without warning, those involving unanticipated night flight, and/or those requiring extended periods of sustained wakefulness are inherently risky because many of the normal fatigue countermeasures cannot be employed. Commanders and pilots should consider the following as risk reduction/risk management tools when flights must be completed despite fatigue or inadequate sleep (in an operational environment):

- Be sure to eat high protein foods like yogurt, cheese, nuts, and meats.
- Avoid high fat foods (candy) and high carbohydrate foods (cereals, breads, etc.).
- Drink plenty of fluids since dehydration compounds fatigue.
- Converse with other crewmembers, and rotate tasks to minimize boredom.
- If possible, try to move around in the cockpit. Definitely exercise during refuels.
- Once fatigue becomes noticeable (but not before), take caffeine in some form.
- In combat situations, request a stimulant such as Dexedrine™ from the flight surgeon.

These strategies may provide some short-term enhancement of alertness, *but with the exception of caffeine and dextroamphetamine, they are only minimally effective.* During peacetime, the best countermeasure, other than adequate sleep, is the judicious use of caffeine which is helpful primarily for people who ordinarily don't drink coffee, tea, or caffeinated sodas. However, it's important to remember that regardless of which countermeasures are used, someone who has been awake for 18 hours or more is seriously impaired, particularly if the flight occurs from 0300 to 0900 with no prior sleep. Even the most powerful prescrip-

tion amphetamines are no substitute for sleep!

### So What's the Bottom Line?

Fatigue is a serious threat to the military as an organization and the individuals who make up each unit, whether ground troops or aviators. Adequate, restful sleep is a biological need like hunger or thirst, and it's the only cure for fatigue—there is no substitute. Recognizing the threat posed by on-the-job sleepiness, identifying the causes of insufficient sleep, implementing countermeasures to ensure proper rest, and developing crew rest cycles that will ensure well-rested and alert crews are among the best force multipliers. ■

### Short Circuits... continued from page 5

**1991 Volvo 944/945, 1987-91 Volvo 782. Defect:** Chafing of the insulation of the cables feeding the seat heater, power seat motors, and seat belt warning indicator situated under the front seat can occur due to limited space and variations in cables. **Consequence of defect:** This chafing can lead to a low ohm short circuit, possibly causing a passenger compartment fire. (NHTSA Recall No. 97V166, Volvo Campaign No. 82)

**Owners who take their vehicle to an authorized dealer on an agreed-upon service date and do not receive the free remedy within a reasonable time should contact the following numbers:** Volvo, 1-800-458-1552; Toyota, 1-800-331-4331; Isuzu, 1-800-255-5727; Saturn, 1-800-553-6000 (prompt 3); Chevrolet, 1-800-222-1020; GMC, 1-800-462-8782; Oldsmobile, 1-800-442-6537; Ford and Mercury, 1-800-392-3673; Chrysler, Dodge, and Plymouth automobiles, 1-800-853-1403; Jeep and Dodge trucks, 1-800-992-1997; Mazda, 1-800-222-5500; Audi (Volkswagen of America) 1-800-822-2834. ■